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(54) Abstract Title
Data processing

(57) Data processing apparatus for receiving two or more input packetised data streams and for generating an output packetised data stream; in which data packets of the input data streams each have an associated packet identifier; each input data stream provides one or more data services; and a subset of the data packets of each input data stream are control packets containing identification data defining one or more packet identifiers of data packets for each of the data services of that data stream; comprises means for defining a subset of the data services available across the input data streams; a packet selector for selecting, from each input data stream, data packets and control packets relating to the subset of the data services; and means for concatenating the selected data packets into a single output packetised data stream. In the MPEG-2 digital TV conditional access system described the data services are channels, elemental services (such as video or audio components) or programme listings. The arrangement allows a user to watch two channels simultaneously (eg in different rooms or picture-in-picture) without multiple hardware.

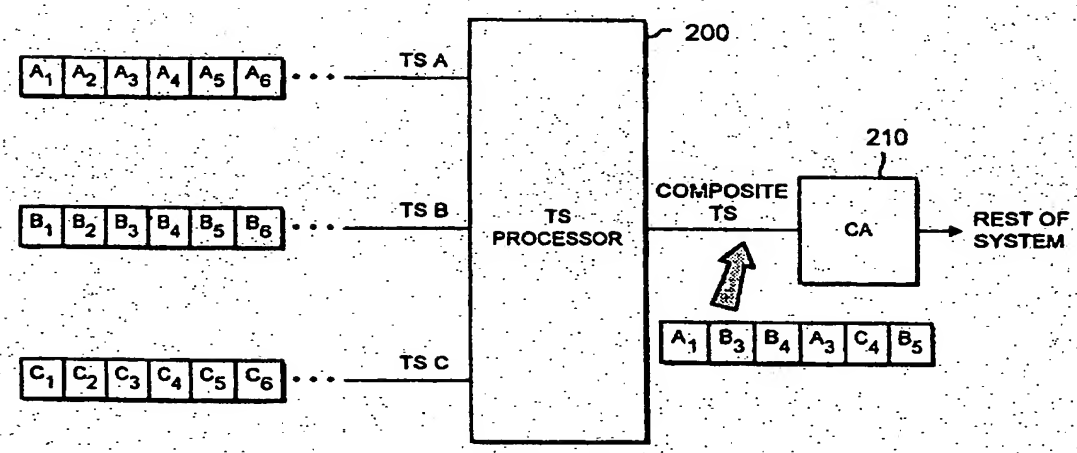

FIG. 4

GB 2 355 618 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

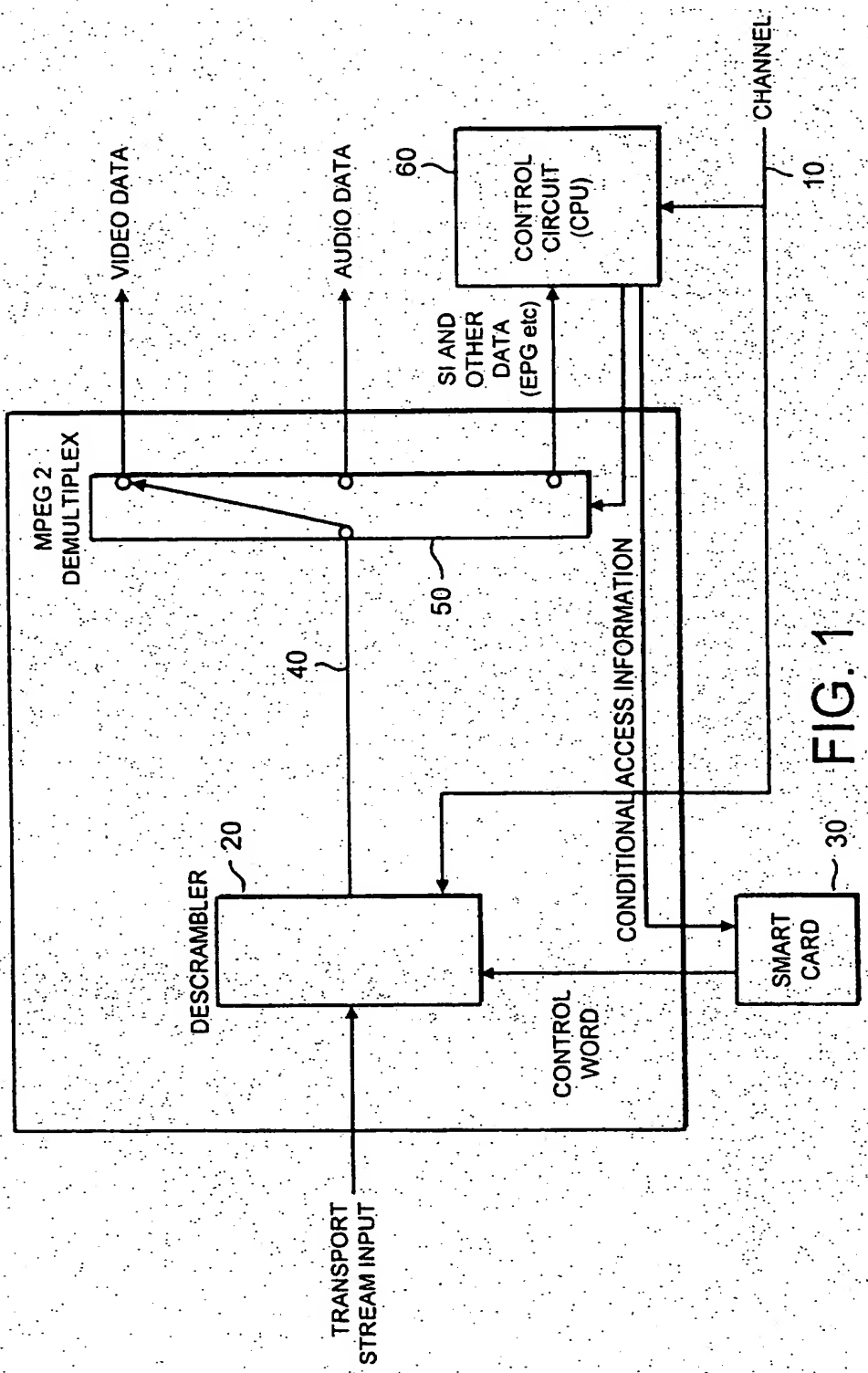
VIDEO DATA
AUDIO DATA
60
CONTROL CIRCUIT (CPU)
CHANNEL
10
SI AND OTHER DATA (EPG etc)
MPEG 2 DEMULTIPLEX
50
40
CONDITIONAL ACCESS INFORMATION
DESCRAMBLER
20
SMART CARD
30
CONTROL WORD
TRANSPORT STREAM INPUT

FIG. 1

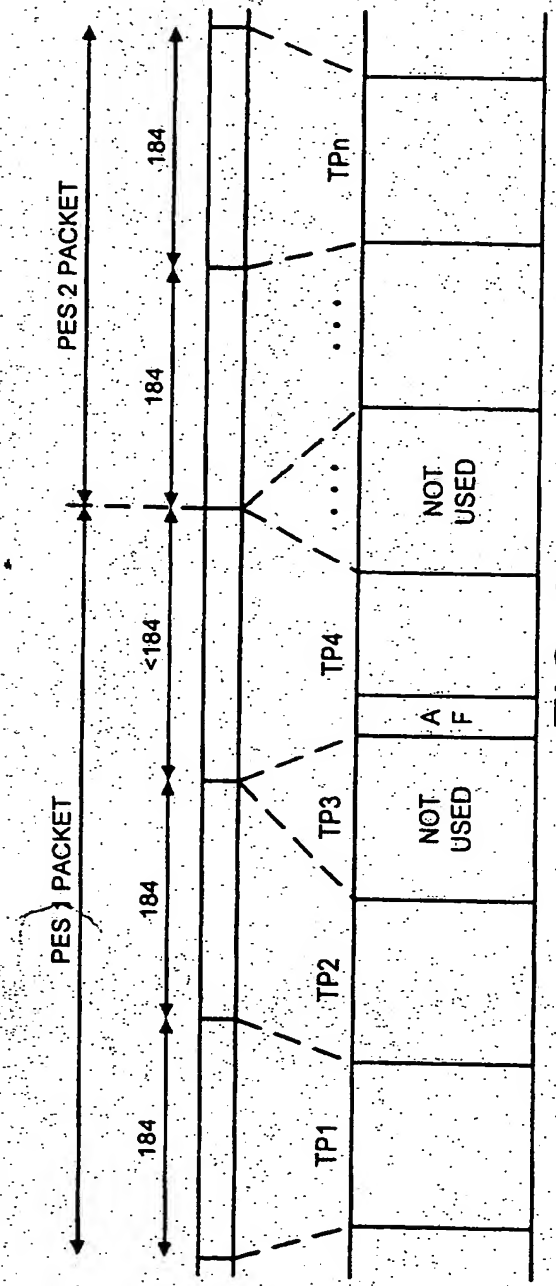
PES 2 PACKET
PES PACKET
184
184
<184
184
184
TP1
TP2
TP3
TP4
TPn
NOT USED
NOT USED
A F

FIG. 2

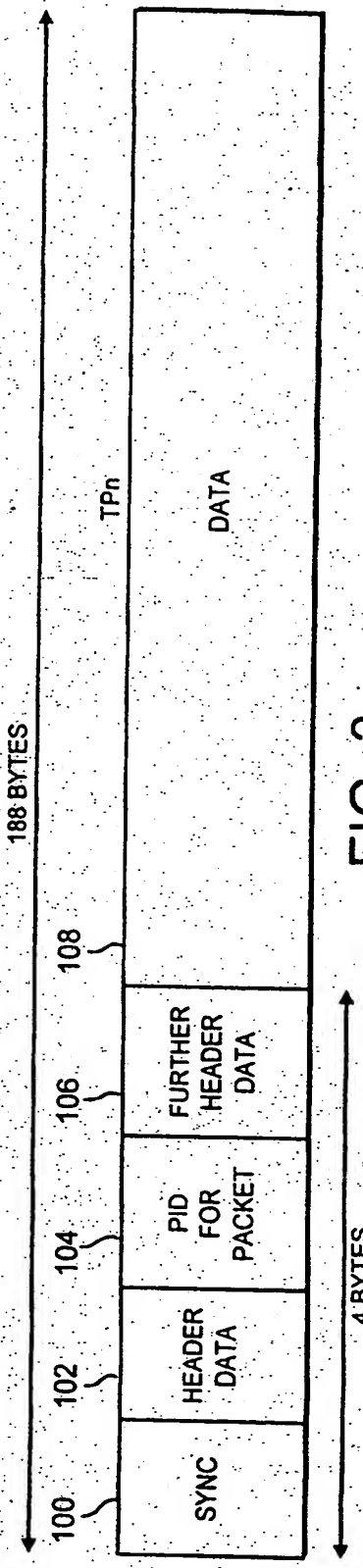
188 BYTES
100
102
104
106
108
SYNC
HEADER DATA
PID FOR PACKET
FURTHER HEADER DATA
TPn
DATA
4 BYTES

FIG. 3

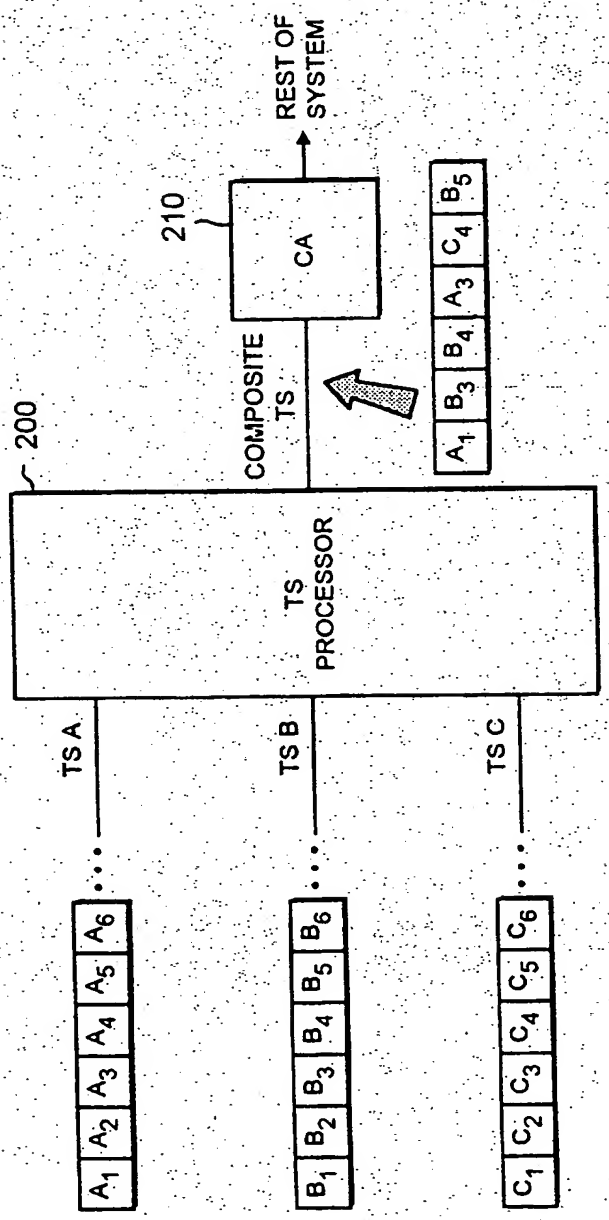
200
TS PROCESSOR
TS A
TS B
TS C
COMPOSITE TS
210
CA
REST OF SYSTEM
A1 A2 A3 A4 A5 A6
B1 B2 B3 B4 B5 B6
C1 C2 C3 C4 C5 C6
A1 B3 B4 A3 C4 B5

FIG. 4

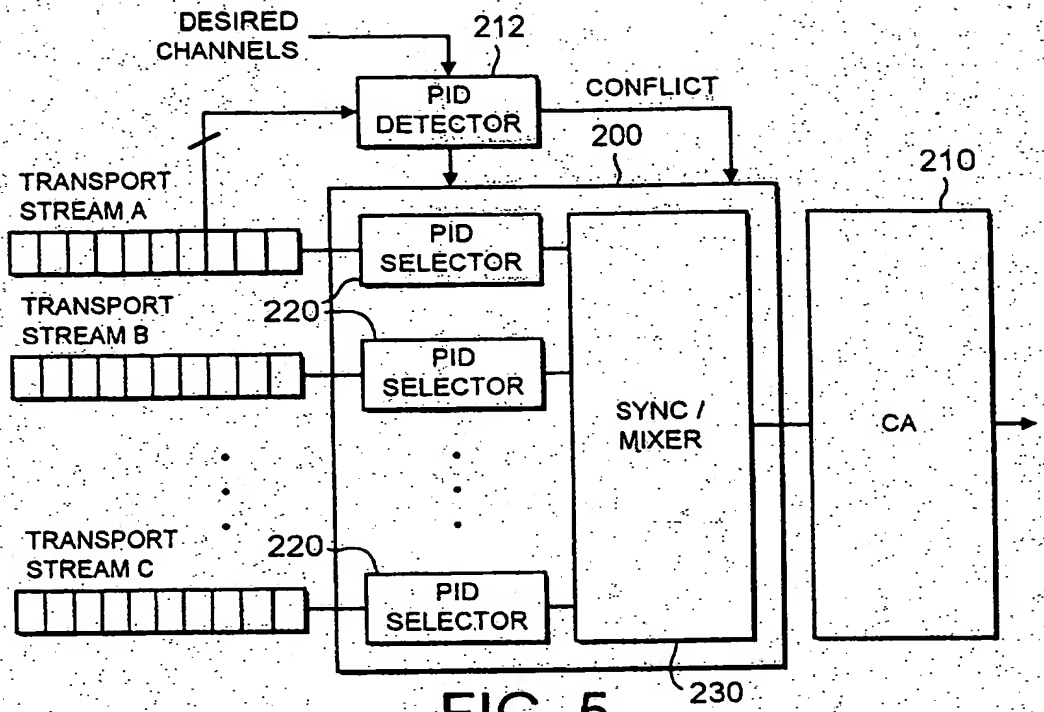
DESIRED CHANNELS
212
PID DETECTOR
CONFLICT
200
210
TRANSPORT STREAM A
PID SELECTOR
TRANSPORT STREAM B
220
PID SELECTOR
SYNC / MIXER
CA
TRANSPORT STREAM C
220
PID SELECTOR
230

FIG. 5

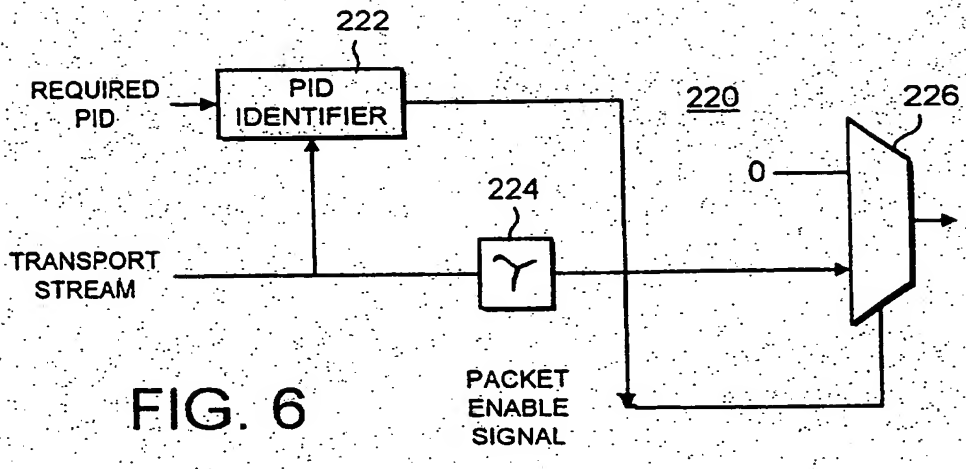
222
REQUIRED PID
PID IDENTIFIER
220
226
0
224
TRANSPORT STREAM
PACKET ENABLE SIGNAL

FIG. 6

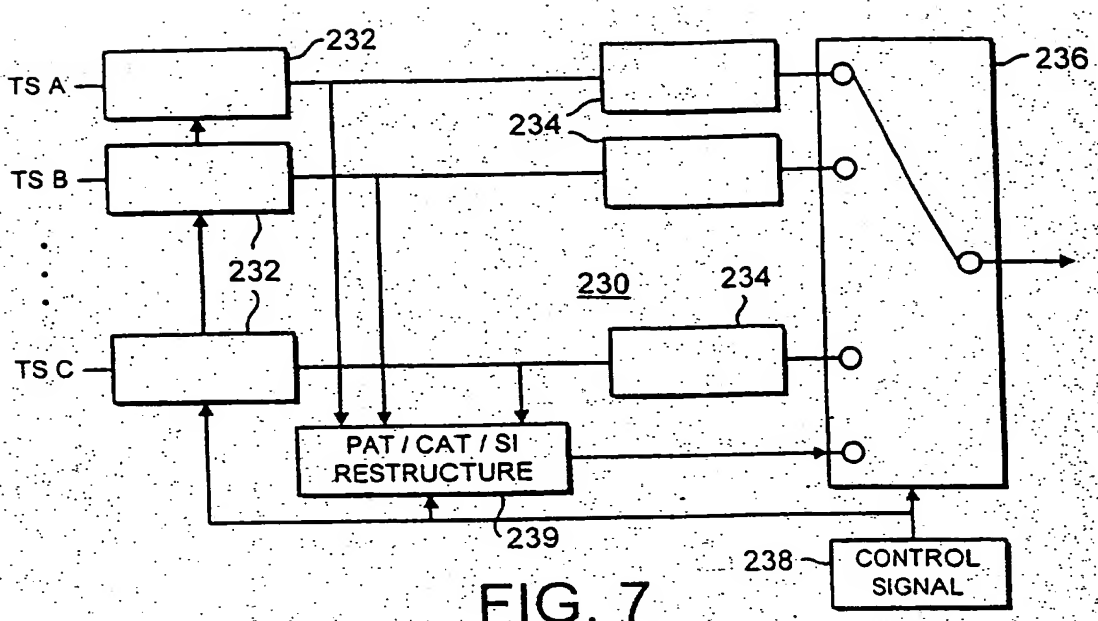
TS A
TS B
TS C
232
232
234
234
230
236
PAT / CAT / SI
RESTRUCTURE
239
238
CONTROL
SIGNAL

FIG. 7

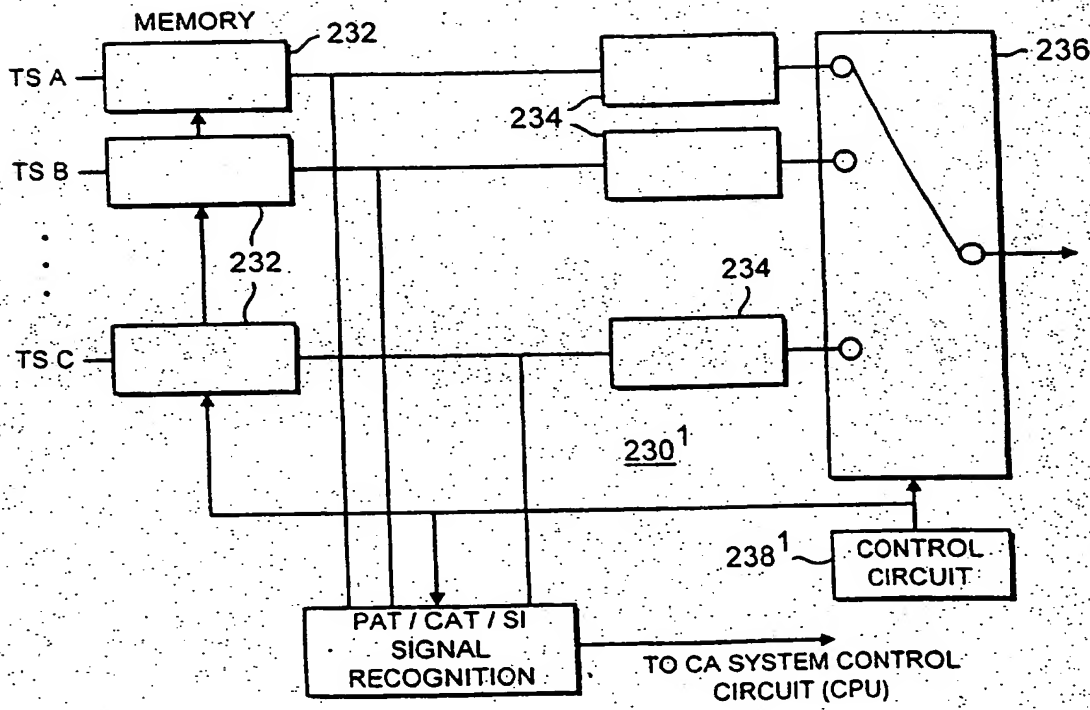
MEMORY
TS A
TS B
TS C
232
232
234
234
236
230 1
238 1
CONTROL
CIRCUIT
PAT / CAT / SI
SIGNAL
RECOGNITION
TO CA SYSTEM CONTROL
CIRCUIT (CPU)

FIG. 8

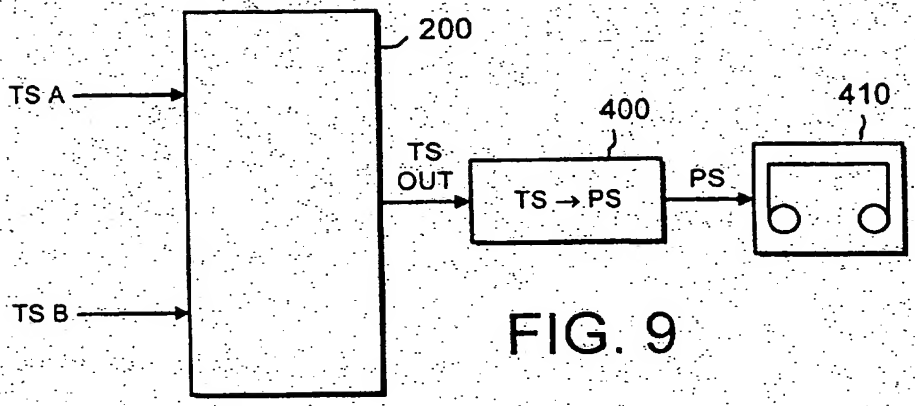

FIG. 9

DATA PROCESSING

This invention relates to data processing.

A major area of data processing is that involved in digital broadcast transmission and reception.

In a digital television receiver for receiving terrestrial or satellite broadcast digital television signals, a conditional access (CA) system is generally used to control which of the received channels can be viewed by the user.

Conditional access is an important part of digital television technology. CA systems allow users to select which channels they wish to receive out of the (typically) large number broadcast over that network, so that the user need not pay for unwanted channels. CA systems also allow the broadcaster to control the geographical area over which a particular channel can be viewed. For example, although a satellite's signal footprint might extend outside a particular country, copyright agreements might prohibit certain channels or programmes from being broadcast to neighbouring countries. So, only those CA systems in the target country might be enabled for reception of the channels or programmes.

At least in the United Kingdom and some other countries, digital television channels are broadcast using MPEG-2 data compression and are grouped together into so-called transport streams or multiplexes. A typical transport stream may carry packets of data relating to about six separately viewable channels, along with control packets defining packet identifiers for the data relating to each elementary service forming those channels, accompanying data such as service information and perhaps some further audio channels.

The terminology used in this discussion will be as follows. A ***programme*** is a single receivable item as far as the viewer/listener/consumer is concerned, such as a television news bulletin or an episode of a documentary or drama. A programme will generally (though not always) be formed of two or more ***elementary services*** such as a video component, some audio components and possibly some associated data components. As mentioned above, the elementary services are all carried separately by

the transport stream. A ***channel*** is a collection of associated successive programmes transmitted in a common manner. An example might be the television channel "BBC1". ***Service information*** is background information providing, for example, a list of programmes being carried by each available channel.

In order to provide conditional access to television channels within a multiplex, at least the data representing television channels within the multiplex is encrypted using one or more encryption keys. These keys are required at the receiver in order to decrypt the data; without them the encrypted data cannot be used to generate a viewable television signal.

Figure 1 of the accompanying drawings is a schematic diagram of a conventional CA system at a digital television receiver.

The CA system operates under the control of a control processor 60 on a single transport stream provided by a signal demodulator (not shown). The user selects a desired channel to be viewed on a channel input 10, for example by specifying the channel using a remote commander (not shown).

The transport stream is passed to a descrambler 20. The descrambler is connected to a smart card 30 which holds decryption keys provided by the broadcaster and conditional access information defining which channels the user has access to. The output of the descrambler forms a composite data stream of video, audio and ancillary data which is separated out for further processing (e.g. display) by a demultiplexer 50.

A problem which exists with this arrangement is that current CA systems and associated hardware can operate on only one transport stream at a time. If the user wishes to watch two programmes simultaneously (for example, in different rooms or as a picture-in-picture arrangement), multiple sets of hardware are required, which would require the user to pay two subscriptions to the programme or channel provider.

It is noted here that in some current broadcast systems, commercial constraints mean that the user is in fact barred from viewing two channels at a time. However, as mentioned these are commercial rather than technical constraints.

The arrangement described above also places constraints on the programme originators, in that the related information, such as audio, video, still images, text

information etc for a particular programme must all be carried in a single transport stream. This restriction can affect the efficiency with which services can be packed into the transport streams.

This invention provides data processing apparatus for receiving two or more input packetised data streams and for generating an output packetised data stream; in which:

data packets of the input data streams each have an associated packet identifier;

each input data stream provides one or more data services; and

a subset of the data packets of each input data stream are control packets containing identification data defining one or more packet identifiers of data packets for each of the data services of that data stream;

the apparatus comprising:

means for defining a subset of the data services available across the input data streams;

a packet selector for selecting, from each input data stream, data packets and control packets relating to the subset of the data services; and

means for concatenating the selected data packets into a single output packetised data stream.

The invention addresses the above problems by the counter-intuitive approach of combining selected data services (e.g. elementary services forming broadcast programmes) and their associated control data from multiple input data streams (e.g. transport streams) to form a single output data stream. This can then be handled by the CA or other systems as though it had been directly received as a single transport stream. This ability to rearrange the transport stream structure avoids the need to use multiple sets of receiving equipment or multiple CA systems.

Further respective aspects and features of the invention are defined in the appended claims.

The invention will now be described by way of example with reference to the accompanying drawings, throughout which like parts are referred to by like references, and in which:

Figure 1 is a schematic diagram of part of a digital television receiver;

Figure 2 is a schematic diagram illustrating the structure of an MPEG-2 transport stream;

Figure 3 is a schematic diagram illustrating the structure of an MPEG-2 transport packet;

Figure 4 is a schematic diagram of a transport stream processor according to an embodiment of the invention;

Figure 5 schematically illustrates the transport stream processor in more detail;

Figure 6 schematically illustrates a PID selector circuit;

Figure 7 is a schematic diagram of a transport packet synchroniser for use with a single service information feed;

Figure 8 is a schematic diagram of a transport packet synchroniser for use with multiple service information feeds; and

Figure 9 is a schematic diagram illustrating the use of a transport stream processor in conjunction with a digital video recorder.

Referring now to Figure 2, the structure of an MPEG-2 transport stream (TS) used in some examples of digital video broadcasting systems will now be described.

The TS is a convenient way of transporting compressed data - generally but not exclusively television programmes - over transmission media or environments subject to relatively high error rates such as a bit error rate (BER) of greater than 10^{-4}. (This contrasts with the so-called program stream (PS) format which is intended for quasi error free media such as CD-ROMs where the BER is expected to be more like 10^{-10}). So, the TS format is well suited to terrestrial or satellite broadcasting of television programmes.

In order to alleviate the effects of bit errors, the data is divided up into relatively short transport "packets" which are 188 bytes long. The central row of Figure 2 schematically illustrates a repetitive structure of evenly-sized transport packets TP1 ... TPn. The intention behind the division into transport packets is of course that if one packet is corrupted, another packet from the same television programme will hopefully not be corrupted and so the missing data can either be reconstructed (if error correction

is employed) or concealed using the successfully recovered data.

The structure of a transport packet is shown schematically in Figure 3. Of the 188 bytes of the transport packet, the first 4 bytes are a transport packet header formed of an eight bit synchronisation word 100; three bit header data 102 containing flags indicating a transport priority, a payload unit start indicator (see below) and a transport error indicator; a 13 bit packet identifier (PID) 104 (see below) and a further six bits of header data including a transport scrambling control flag, an adaptation field control flag and a continuity counter so that missing packets can be detected.

The remaining 184 bytes 108 of the transport packet carry the data payload.

The data payload of a transport packet is taken from a packetised elementary stream (PES). A PES is formed by taking an MPEG-2 elementary stream - in other words, the output of a single MPEG-2 audio or video encoder - and dividing it up into packets. The packets do not have to be 184 bytes long, and in fact generally are of very different lengths to this. Indeed, while the detailed structure of a PES packet will not be described here (reference is made to standard textbooks on MPEG-2 such as "Digital Television", H Benoit, 1997, ISBN 0 340 69190 5) it is sufficient to say that the length of a PES packet is defined by a 16 bit "packet length" variable in the PES packet header, so that PES packets could have a maximum length of 64 kilobytes.

So, as the PES packet may well be of a greater length than the payload capacity of a single transport packet, PES packets are generally partitioned up to fit into multiple transport packets. This process is illustrated in Figure 2. Along the top of Figure 2, two PES packets are illustrated (on an expanded horizontal scale compared to the TS packets below). A packet from PES 1 takes up three TS packets, TP1, TP2 and TP4. TP3 is unused, and so is padded with stuffing data. At the end of PES 1 packet, the last TS packet containing the PES 1 packet starts with a so-called adaptation field, which is also stuffing data equal in length to 184 bytes minus the remaining amount of data of that PES packet.

The process then continues for the packet from PES 2, and so on.

It is therefore clear that the TS can simultaneously transport more than one programme, each being composed of one or more PESs. So, in order to decode a

particular programme, it is therefore clear that a conventional digital television receiver must be able to pick out the relevant TS packets from the transport stream and re-concatenate them into packets of the required PESs. Some further data tables are provided in the TS to allow this to take place efficiently.

(a) The Programme Allocation Table (PAT)

This table has to be included in the TS without any scrambling or conditional access, in accordance with the MPEG-2 standard. It can easily be located by the receiver as the PID for packets carrying this table is always defined as zero. The detailed structure of the PAT is described in many other places, but its relevance here is that it defines, for each programme carried by the TS, the PID of packets containing a programme map table (PMT) for that programme. The PMT PIDs can be arbitrary values apart from the reserved values of 0 and 1. So, once the PAT has been decoded from the TS, the PIDs of the PMTs can be used to access each PMT from the TS.

The PAT can also define the PID of an optional network information table (NIT) - see below.

(b) The Programme Map Table (PMT)

Each programme transmitted using the TS has a respective PMT. Again, the detailed structure of a PMT is complicated and is described well elsewhere, but it should be noted here that the PMT defines the PID(s) of the PES(s) making up that programme. The PMT can also carry ECM data (see the description of the CAT below).

(c) The Conditional Access Table (CAT)

This table is carried by TPs of PID=1 and contains data defining the CA system used for the PESs using CA.

As before, the detailed structure of the CAT is complicated and well

documented elsewhere, but for the present purposes the following information is given.

Generally, conditional access or unscrambling systems require Conditional Access Messages (CAMs) formed of two pieces of information to unscramble a programme: one of the CAM constituents is the so-called Entitlement Control Message (ECM) carried with the respective PMT or carried in packets having a PID defined by that PMT, and the other is the so-called Entitlement Management Message (EMM) transmitted via packets having a PID defined by the CAT. Each of the ECM and the EMM is retransmitted every few seconds. The information derived from them is combined with information available at the STB, for example in the smart card 30, to provide the keys to unscramble the scrambled signal.

So, an important feature of the CAT is that it carries PID definitions to specify packets in that TS which carry EMM information for programmes carried by that TS.

There are further optional tables which are defined not by MPEG-2 but by the "DVB" broadcasting standard. These are grouped together under the general term "DVB-SI", where SI stands for service information. Together, the SI tables provide information to allow the receiver to configure itself automatically and to build an electronic programme guide (EPG) to assist the user to make use of the receiver and the available programmes.

The DVB-SI data will now be described.

(a) Network Information Table (NIT)

This table carries data relating to a single broadcasting network having programmes carried by more than one TS, and in particular by more than one radio frequency (RF) carrier. The data might include RF frequencies or satellite channel numbers.

(b) Service Descriptor Table (SDT)

This lists the names of each programme service in the TS.

(c) Event Information Table (EIT)

This can relay information about broadcasting "events" in the same or another TS.

(d) Time and Date Table (TDT)

This table carries the current time and date to enable an update and synchronisation of the time and date held by the receiver or set top box (STB).

Figure 4 is a schematic diagram of a transport stream processor 200 according to an embodiment of the invention. The processor may be embodied as a stand-alone unit, as part of a television transmitter, receiver or set-top box (here it is noted that the term "set-top box" is used in the art to mean a television signal pre-processor rather than to define any physical position or orientation relative to a "set") or as software running or stored on or by a general purpose computer.

In Figure 4, three separate input transport streams are illustrates schematically as TS A, TS B and TS C. TPs within each TS are numbered, so that TS A contains TPs A_1, A_2, A_3 . . . and so on.

The internal operation of the processor 200 will be described below, but in general terms the processor can be employed upstream of the CA system of Figure 1 (shown schematically here as a single element 210). In this configuration, the processor extracts TPs from two or more input TSs to generate an artificial or composite TS to be processed by the remainder of the receiver. In other words, although the receiver may be capable of handling only one TS, using the transport stream processor of Figure 4 selected programmes or even elementary services from more than one TS can be received as though they had been originally broadcast on a single TS.

In the schematic example shown, the composite TS which is output by the TS processor carries TPs $A_1\ B_3\ B_4\ A_3\ C_4\ B_5$ . . .

Based on the above discussion, it will be appreciated that there is more to this process than simply switching between TPs; significant care has to be taken to ensure

that the remainder of the receiver is supplied with correct ancillary data such as the PAT, PMT and so on. These processes will be described in greater detail below.

Figure 5 illustrates the operation of the transport stream processor 200 of Figure 4 in a little more detail.

The processor 200 comprises a PID detector 212, an array of PID selectors 220 and a synchroniser/mixer 230.

The PID detector 212 receives information from a user control (not shown) or a memory store (not shown) defining a set of channels, programmes or elementary services required by the user. It also receives the transport streams TS A, TS B and TS C. From the PATs, PMTs, CATs etc of these transport streams the PID detector derives a list of PIDs to be extracted from each of the input TSs and supplies respective lists to each of the PID selectors 220.

Each of the PID selectors 220 is arranged to select only those TPs having particular defined PIDs from the respective input TS. The remaining TPs are not passed by the PID selectors.

So, if for example a particular programme in TS A is required to be present in the composite TS output by the processor 200, transport packets corresponding to that programme have to be selected by the PID selector for TS A. The selected TPs will be the TPs for all of the PESs carrying that programme, the TPs carrying the PMT for that programme, and the TPs carrying the CAT, PAT and SI information, although these are in fact discarded and replaced by a new CAT, PAT and SI rather than being used directly in the output composite TS.

This process goes on for each of the PID selectors. As mentioned above, the set of programmes to be carried by the composite TS can be pre-set or can be selectable by the user, always subject to the constraint that the sum of all of the selected TPs must be no greater than the capacity of the composite TS output by the processor 200.

Figure 6 schematically illustrates a PID selector 220. The PID selector comprises a PID identifier circuit 222, a delay 224 and a multiplexer or switch 226.

PID identifier circuits are known - *per se* - from conventional digital television receivers. The PID identifier circuit 222 responds to a control input defining one or

more required PIDs and examines each received TP of the TS for those PID values. This is possible because (as described above) the PID occurs at the same position in each TP. The PID identifier circuit outputs a packet enable signal which controls the multiplexer 226 either to pass or not to pass that TP. The delay 224 is simply to compensate for the detection time of the PID identifier circuit.

Figure 7 is a schematic diagram of a transport packet synchroniser 230 for use with a single output service information feed.

The synchroniser 230 comprises an input buffer memory 232 for the selected packets of each TS, a CAT/PAT/SI elimination circuit 234 for each TS, a mixer 236, a system controller 238 and a CAT/PAT/SI reconstruction logic 240.

The controller 238 controls the reading of TPs from each of the input buffer memories to form the majority of the composite TS. Many different algorithms can be used, but one straightforward way of operating this system is to read one TP from each of the buffer memories in turn, subject of course to there being a TP present in that buffer memory.

As each packet is read it is passed to the CAT/PAT/SI elimination circuit for that TS. Here, if the packet represents a part of the CAT, PAT or SI, it is discarded. However, the CAT/PAT/SI reconstruction circuit 239 receives the CAT, PAT and SI packets before they are discarded and uses the information in them to build a new CAT, PAT and SI table relevant to the output composite data stream.

In general, it is unlikely that two tables or PESs to be combined into the output composite TS would have the same PID. PIDs are 13-bit numbers and so have 2^{13} (8192) permutations. Also, items in a single TS are forbidden by ISO standard from having the same PID. However, items combined from two different input TSs could conceivably have the same PID.

This situation is tested for by the PID detector 212 of Figure 5. The PID detector 212 has a further output to the sync/mixer 230 labelled on Figure 5 as "conflict". This output carries the PIDs and TS identifiers of any PIDs found to be the same between required elementary services or other TPs in the output TS. The sync/mixer operates in response to such information to strip the PID from one, both, all

(if more than two) or (all - 1) sets of conflicting TPs and replace those PIDs with PIDs known to be unique amongst those used in the output composite TS.

Of course, items such as the PATs from each of the input TSs would have the same PID as this is defined by convention, but techniques have been described for generating a replacement composite PAT from the relevant PAT data.

Worked Example

For example, consider two input TSs, TS A and TS B. TS A carries two programmes, programmes P and Q, and TS B also carries two different programme, programmes R and S. Each programme is formed of an audio elementary service and a video elementary service. This example ignores the SI data, but that would be treated in a similar manner to the PAT. The PAT, CAT and PMT (in a highly simplified and schematic form purely to illustrate the present technique) of TS A and TS B might define PIDs as follows:

Transport Stream A

PID of this table	Table name	Data contents
0	PAT	PMT (P) has PID = 45 PMT (Q) has PID = 76

PID of this table	Table name	Data contents
45	PMT (P)	PES (P video) has PID = 49 PES (P audio) has PID = 50 ECM (P) has PID = 121

PID of this table	Table name	Data contents
76	PMT (Q)	PES (Q video) has PID = 51 PES (Q audio) has PID = 52 ECM (Q) has PID = 122

PID of this table	Table name	Data contents
1	CAT	EMM (This TS) has PID = 190

PID	Item name	Data contents
121	ECM	ECM for P
122	ECM	ECM for Q
190	EMM	EMM for this TS

Transport Stream B

PID of this table	Table name	Data contents
0	PAT	PMT (R) has PID = 31 PMT (S) has PID = 22

PID of this table	Table name	Data contents
31	PMT (R)	PES (R video) has PID = 17 PES (R audio) has PID = 18 ECM (R) has PID = 151

PID of this table	Table name	Data contents
22	PMT (S)	PES (S video) has PID = 19 PES (S audio) has PID = 20 ECM (S) has PID = 152

PID of this table	Table name	Data contents
1	CAT	EMM (This TS) has PID = 712

PID	Item name	Data contents
151	ECM	ECM for R
152	ECM	ECM for S
712	EMM	EMM for this TS

Composite Transport Stream

Assume that in the composite transport stream, it is desired to have programmes P and S. Accordingly, the PID selectors 220 will select from TS A all TPs having the PIDs 0 (for the PAT), 45 (for the PMT for programme P), and 49 and 50 (for the PESs of programme P). From TS B the PID selectors 220 will select all TPs having the PIDs 0 (for the PAT), 22 (for the PMT for programme S), and 19 and 20 (for the PESs of programme P).

The PAT and SI data of the original TSs is discarded by the PAT/SI eliminators 234. The PAT/SI reconstruction logic would then reconstruct a new PAT, and the PMTs of the relevant programmes would be reused, so that the PAT and PMTs of the output composite TS would be as shown below.

With regard to the ECM and EMM data in the composite output TS, it would be difficult to separate out parts of the ECM and EMM data relevant to each of the selected programmes. So, these items from the input TSs are simply added together to provide the corresponding parts of the output TS. This can be achieved by the new CAT defining all of the PIDs carrying EMM data from the entire set of input TSs, or at least those which contributed at least one elementary service to the output TS.

Composite Transport Stream

PID of this table	Table name	Data contents
0	PAT	PMT (P) has PID = 45 PMT (S) has PID = 31

PID of this table	Table name	Data contents
45	PMT (P)	PES (P video) has PID = 49 PES (P audio) has PID = 50 ECM (P) has PID = 121

PID of this table	Table name	Data contents
31	PMT (S)	PES (S video) has PID = 19 PES (S audio) has PID = 20 ECM (S) has PID = 152

PID of this table	Table name	Data contents
1	CAT	EMM (This TS) has PIDs = 190 and 712

PID	Item name	Data contents
121	ECM	ECM for P
122	ECM	ECM for Q
712	EMM	EMM for this TS
190	EMM	EMM for this TS

Figure 8 is a schematic diagram of a second embodiment of a transport packet synchroniser 230' for use with multiple service information feeds.

The synchroniser 230' of Figure 8 is similar in many respects to that of Figure 7, and corresponding parts (memories 232, PAT/SI eliminators 234 and mixer 236) will not be described again. The operation of the controller 238' is similar in most respects to that of the controller 238 of Figure 7, except in certain respects relating to its interaction with a CAT/PAT/SI signal recognition circuit, which will become apparent by the operation to be described for that circuit.

The CAT/PAT/SI recognition circuit operates to extract CAT, PAT and SI data from the incoming TSs, but in contrast to the arrangement of Figure 7 it does not reconstruct a replacement set of CAT, PAT and SI data. Instead, it passes the "raw" data from the CAT, PAT and the SI tables directly to the CA system (not shown in Figure 8). This saves the CA system having to extract that data itself, and also simplifies the implementation of the synchroniser considerably.

In summary, in the embodiments described above, programmes, data or elementary services from multiple transport streams can be combined into a single composite transport stream which can then be handled by the remainder of a digital television or other receiver or other apparatus as though it had been transmitted as a single TS.

This arrangement has many advantageous applications:

(a) Simultaneous recording/viewing of programmes on different transport streams: often a digital television receiver might allow the user to watch one programme from a transport stream while video recording another programme form the same transport stream. Using the embodiments described above, two programmes from different transport streams could be combined onto a single transport stream, allowing the user to view one programme and record another.

(b) Combining related data from different transport streams: for example moving pictures, still pictures, sound, text, graphics and so on can be combined to be on the same transport stream. This arrangement is shown schematically in Figure 9 where two incoming transport streams, TS A and TS B are combined to form a single composite

output transport stream TS OUT as described above. Optionally, a transport stream to programme stream converter 400 can be used to reformat the data into the known programme stream format for storing on a quasi error free storage medium 410.

(c) Picture in Picture using programmes from two or more different transport streams can be achieved.

It will be appreciated by the skilled man that while the above embodiments have been described in the context of hardware implementations, they could be implemented in software running on a general purpose computer, as custom or software controlled application specific integrated circuits, as hardware or as combinations of two or more of these. It will be appreciated that the appropriate software, and a storage medium such as a disk, tape, memory etc are envisaged as embodiments of the present invention.

CLAIMS

1. Data processing apparatus for receiving two or more input packetised data streams and for generating an output packetised data stream; in which:

data packets of the input data streams each have an associated packet identifier;

each input data stream provides one or more data services; and

a subset of the data packets of each input data stream are control packets containing identification data defining one or more packet identifiers of data packets for each of the data services of that data stream;

the apparatus comprising:

means for defining a subset of the data services available across the input data streams;

a packet selector for selecting, from each input data stream, data packets and control packets relating to the subset of the data services; and

means for concatenating the selected data packets into a single output packetised data stream.

2. Apparatus according to claim 1, in which the input data streams are transport streams carrying, at least in part, video and/or audio data.

3. Apparatus according to claim 2, in which the data services include audio or audio/video elementary services.

4. Apparatus according to claim 2 or claim 3, in which the streams are MPEG transport streams carrying, at least in part, compressed video and/or compressed audio data.

5. Apparatus according to claim 4, in which the control packets are packets of the MPEG programme map table (PMT).

6. Apparatus according to any one of the preceding claims, in which the control packets define a group of two or more packet identifiers relating to each data service.

7. Apparatus according to any one of the preceding claims, in which, for each data stream, a subset of the packets are allocation packets containing data defining at least the packet identifiers for each of the control packets of that data stream.

8. Apparatus according to claim 7, in which the allocation packets of the data streams have the same, predetermined, packet identifier.

9. Apparatus according to claim 7 or claim 8, comprising:

means for receiving the allocation packets for at least those input data streams carrying a data service in the subset of data services;

means for detecting parts of the data of the allocation packets which relates to data services in the subset of data services and generating replacement allocation packets using this data; and

means for inserting the replacement allocation packets into the output data stream.

10. A television receiver comprising apparatus according to any one of the preceding claims.

11. A set-top box comprising apparatus according to any one of claims 1 to 9.

12. A method of data processing in which an output packetised data stream is generated from two or more input packetised data streams and for generating an output packetised data stream;

data packets of the input data streams each having an associated packet identifier;

each input data stream providing one or more data services; and

a subset of the data packets of each input data stream being control packets containing identification data defining one or more packet identifiers of data packets for each of the data services of that data stream;

the method comprising the steps of:

defining a subset of the data services available across the input data streams;

selecting, from each input data stream, data packets and control packets relating to the subset of the data services; and

concatenating the selected data packets into a single output packetised data stream.

13. A computer program having program code for carrying out a method according to claim 12.

14. A storage medium carrying a computer program according to claim 13.

15. Data processing apparatus, a television receiver, a set-top box, a method of data processing, computer software or a storage medium substantially as hereinbefore described with reference to Figures 4 to 7 and 9 or Figures 4 to 6, 8 and 9 of the accompanying drawings.

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Application No: GB 9924857.7 **Examiner:** Ken Long
Claims searched: 1 to 15 **Date of search:** 26 April 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): H4P (PPS)

Int Cl (Ed.7): H04L (12/56)

Other: ONLINE : EPODOC, WPI, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB 2338388 A	ACTV (page 3 lines 10-23)	None
X	GB 2315649 A	MITSUBISHI (see particularly page 1 lines 15-22, page 4 line 5 to page 5 line 11, page 12 lines 1-11, page 12 line 17 to page 13 line 3 and claims 1, 8 & 9)	1 to 5 and 10 to 12 at least
X	GB 2313755 A	GENERAL INSTRUMENT (page 1 lines 5-7, page 6 lines 10-15, page 7 lines 19-27, page 12 line 16 to page 13 line 7, page 23 lines 5-16 and page 25 line 13 to page 26 line 8)	1 to 5 and 10 to 13 at least
A	WO 97/46009 A1	THOMSON CONSUMER ELECTRONICS	None
A	US 5847771	BELL ATLANTIC	None

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